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ABSTRACT

This study investigated the relationship between cognitive style and the use of play areas in the nursery school. The participants were 28 preschool children (13 girls and 15 boys) attending the Laboratory Nursery School at the University of California at Davis. Each child was observed for 12 one-hour sessions over a 10-week period. A time sampling approach was used to record the area(s) of the nursery school occupied by the observed child, the equipment the child used, and the type of activity which occupied the child during the observation period. Analytic perceptual ability was measured by the Preschool Embedded Figures Test (PEFT) and the Block Design Subtest of the Wechsler Preschool and Primary Scale of Intelligence (WPPSI). The findings indicated a slight but statistically insignificant correlation between the analytic measures and use of space for girls with PEFT and for boys with the WPPSI Block Design subtest. These results are discussed and methodological problems are pointed out. (JMB)

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RELATIONSHIP BETWEEN USE OF PLAY AREAS AND COGNITIVE STYLES IN PRESCHOOL CHILDREN[1]

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28 children, 3 1/2 to 5 1/2 years old, were observed daily in nursery school play and were administered 2 tests of analytic perceptual ability. (Slight but statistically insignificant correlations between analytic measures and use of space were found for girls with the Preschool Embedded Figures Test (PEFT) and for boys with the WPPSI Block Design subtest. A discriminant function test classified males and females into groups which differed significantly in their use of space ($X^2 = 4.08$, $df = 1$, $p < .05$). ANOVA revealed that the difference between males and females on one of the play-space measures approached significance ($.05 < p < .06$). A two-tail t-test found no significant difference between males and females in either the PEFT or the Block Design subtest.

This study was conducted to investigate the relationship between cognitive style and the use of play areas in the nursery school. Although there is considerable literature on animal uses of space, the literature concerning human utilization of space is limited. One severly neglected area is the way in which children employ space. In many observations of preschool children this investigator has noted that individuals or groups habitually use particular areas and reveal specific styles of play while in those areas. A second observation is that many distinctive styles of behavior of boys and girls seem sex-specific.

In applying ethological concepts to understanding of uncontrived behavior, and designing an experiment for study of nursery school children's use of play space, it is necessary to determine the formal dimensions of space in which the children interact. Specifically, this study is concerned with the child's orbit, or use of delineated and numbered play areas inside and surrounding his nursery school.

Research on children's play patterns reveals marked sex differences with the beginning of self-initiated play. Zazzo and Jullien (1954) reported that boys generally prefer vigorous play involving muscular strength, dexterity, and physical exertion. During the preschool years they surpass girls in restlessness, general activity, and use of large play areas (Otterstaedt, 1962). Boys as compared to girls, play more often with blocks, a spatial task (Farrell, 1957), and with all kinds of vehicles, and choose more distant, varied, and difficult goals (Vance & McCall, 1934). Girls, in contrast, prefer sedentary games, use a smaller play space, are less interested in blocks and vehicles, and choose easier and nearer goals. Boys tend to build tall structures, enjoy defiance of gravity, and sometimes destroy their own creations, while girls build more

horizontal structures with static interiors (Erickson, 1951). Boys' greater interest in manipulating objects is contrasted with girls' greater interest in social relationships (Goodenough, 1957).

Numerous studies (Borstelman, 1961; Brown, 1957, Conn, 1951; DeLucia, 1963; Garai, 1966; Hetherington, 1965) have found that behavior becomes increasingly "sex-typed" in the first three years of life. From the age of three on, boys demonstrate in their choice of games a consistent preference for the masculine role, while the preference of girls for the feminine role seems to develop at a later age. As expected, though, some boys employ play areas in a style characteristic of girls, just as some girls employ play areas in a style characteristic of boys.

A study of cognitive style (Witkin, Dyk, Faterson, Goodenough & Karp, 1962) found that a child's approach to the world can be characterized quite generally along an analytical versus a global dimension. This dimension finds expression in perceptual functioning and has been studied most frequently through measures of field-dependence, which is defined as an inability to overcome the context of a perceptual situation and a reluctance to explore beyond the obvious cues. Thus, field-dependent people are easily influenced by misleading cues. From infancy on, males are usually superior to females in the perception, judgment, and manipulation of spatial relationships (Garai & Scheinfeld, 1968). This is based in part on the greater "field-independence" of males. Females are generally more dependent on the peripheral visual field than are males in judging spatial relations. The female appears to exhibit a more global approach than the male in perception of spatial relationships, which causes her to perceive the stimulus and its setting (peripheral field) as closely interconnected. Males, in contrast, tend to be more analytic in their perceptual approach to the environment. This analytic approach may enable them to separate the target from its external setting and to concentrate upon it, undisturbed by the surrounding visual field. These differences are likely to influence separate cognitive styles and modes of thinking in the overall problem-solving approach of the two sexes. Again, as in the use of play areas, there are boys who reveal cognitive styles characteristic of girls, and girls who reveal cognitive styles characteristic of boys.

In summary, studies indicate that boys and girls usually establish separate styles in using play areas which are characteristic of each sex, and that there are comparable sex differences in cognitive styles.

It is hypothesized that:

1. A wide coverage of space and the use of a wide range of equipment are accompanied by an analytical (rather than a global) style of visual perception, both for the sexes combined and for each sex separately.
2. Males cover a wider area and use more equipment than females.

3. Males are perceptually more analytic than females.

Method

Subjects

The subjects were 28 healthy children (13 girls and 15 boys), 3 1/2 to 5 1/2 years old, enrolled in the Laboratory Nursery School at the University of California at Davis. All but three of the families were from the college community. Social classification was carried out on the basis of the Two-Factor Index of Social Position (Hollingshead, 1957). Twenty-one of the 28 families ranked in class 1 (the highest rank). The remaining 7 families did not fit into Hollingshead's scheme, the fathers being currently full-time students.

Procedure

Observation of use of space in children's play. The entire nursery school area was subdivided into conspicuously numbered regions for an ongoing study of the use of space. Seven observers were trained to record the child's behavior by time sampling, thus observation and recording yielded quantitative descriptions and a mapping of each child's use of delineated areas. Fifteen-second intervals were indicated to each observer by portable electric timers, delivering an auditory signal through an earphone. The observer watched (for a short while, e.g., 10 seconds) and then took a brief period to record on a pre-coded sheet before proceeding to the next geographical number(s) indicating the area(s) occupied by the observed child, the pieces of equipment (toys, apparatus), and the type of activity which occupied the child during that period. This provided a quantifiable record, but did not obviate the problem of data lost during the recording period.

Collection of data began in the first week of October 1971 and continued throughout the following 10 weeks. The observers stationed themselves where their coverage of play areas would be maximum without blocking normal school activities. The observations were made in approximately one-hour blocks, beginning at 9:00 A.M. (when the children arrived) and ending at juice time (around 10:00 A.M.). Each observer watched one child each day. The children were observed on a continuous rotation schedule, yielding 12 observation periods per child. This was designed to provide a representative sample of each child's characteristic use of space in play.

Measures. The recorded observations yielded the following play-space scores for each subject. These measures were employed in testing Hypotheses 1 and 2.

1. Mean areas entered. The 10-week mean of the number of separate areas entered per day.
2. Area changes. The 10-week mean of the number of times the child changed from one area to another per day.
3. Mean equipment used. The 10-week mean of the number of separate pieces of equipment used per day.
4. Longest duration (area). The 10-week mean of the longest duration in any single area per day.
5. Longest duration (equipment). The 10-week mean of the longest duration per day with any separate piece of equipment.
6. Mean duration (equipment). The 10-week mean of the means duration per day with equipment.

$$\frac{\text{Sum of duration with equipment per day}}{\text{N pieces of equipment used}}$$

then

$$\frac{\text{Sum of mean durations with equipment per day}}{\text{N days}}$$

When a child was in transit (running from one area to another) during an entire 15-second interval neither the areas entered nor the time interval was included in the above scores.

Measure of analytic perceptual ability. Analytic ability in visual perception was measured by the Preschool Embedded Figures Test (PEFT), a measure of field-dependence (Coates, 1969), and the Block Design subtest of the Wechsler Preschool and Primary Scale of Intelligence (WPPSI) (Wechsler, 1967). Two students, ignorant of the findings on use of space, administered these tests beginning half-way through the quarter.

Scores of analytic perceptual ability. The following scores were obtained for each subject from the PEFT and Block Design.

7. The Block Design score was determined according to the WPPSI manual. A few children in this study were below the lowest age limit for the WPPSI scaled-score Block Design norms. The table for obtaining scaled scored for these subjects was for children between three-years-sixteen-months--sixteen-days through four-years-one-month-fifteen-days.
8. The PEFT score was the sum of S's correct responses divided by the sum of the time taken per response.

Analysis of Data

To test Hypothesis 1, Pearson product-moment correlations were computed among all variables, with both sexes combined and each sex analyzed separately. Three-factor analyses (similar rotations of measures) were

done with the sexes combined to obtain a refined analysis of the relationship among all variables.

The first step in testing Hypothesis 2 was required computation of Mahalanobis (D^2) discriminant function test (Rao, 1952). Variables that discriminated powerfully were employed in a repeated measures analysis of variance.

A two-tail t-test for sex differences on analytic scores was used as a test for Hypothesis. Pearson product-moment correlations measured the relationship between the two analytic variables (PEFT and Block Design).

Results

As to Hypothesis 1, with the sexes combined the PEFT showed slight nonsignificant correlations with some of the play-space scores; the Block Design showed even lower correlations (Table 1, Rows 7 and 8). When analyzed for each sex separately, there were slight (about equal) nonsignificant negative correlations (the predicted direction) between the PEFT and the duration play-space scores. The sexes differed, however, in correlations between the PEFT and play-space variables having to do with the amount of space covered, the frequency with which the child changed areas, and the amount of equipment used. Tables 2 and 3, Row 8, Columns 1, 2, and 3, show that, with each of these variables, the correlations with the PEFT, although not significant, were higher for the girls than for the boys. Although the correlations between the PEFT and these play-space scores were higher for the girls, the nonsignificant correlations between Block Design and play-space scores were generally higher for the boys (Tables 2 and 3, Row 7).

In an effort to compare the sexes on the reliability of the play-space measures, this investigator determined which correlation coefficients differed for the sexes by 15 points or more. For example, Tables 2 and 3, Row 1, Column 4, show that the correlation between mean areas entered and longest duration (areas) was -.54 for the males and -.74 for the females. In 10 of the 11 instances, the differences were in the direction of higher correlations for females than for males; the exception was that the correlation between variable 2 (area changes) and variable 3 (mean equipment used) was higher for boys. Apparently the play-space variables measured the same thing more consistently for girls than for boys.

Table 1

Pearson Product-Moment Intercorrelations for Play-Space and Analytic Scores for the Sexes Combined

Variable	1	2	3	4	5	6	7	8
1. Mean Areas Entered		.85***	.57***	-.65***	-.64***	-.78***	.06	.23
2. Area Changes	.85***		.78***	-.55***	-.54***	-.74***	.17	.17
3. Mean Equipment Used	.57***	.78***		-.40*	-.18	-.55***	.07	.15
4. Longest Duration (Area)	-.65***	-.55***	-.40*		.79***	.81***	-.14	-.28
5. Longest Duration (Equipment)	-.64***	-.54***	-.18	.79***		.84***	.04	-.26
6. Mean Duration (Equipment)	-.78***	-.74***	-.55***	.81***	.84***		-.10	-.18
7. WPPSI Block Design	.06	.17	.07	-.14	.04	-.10		-.22
8. PEFT	.23	.17	.15	-.28	-.26	-.18	-.22	

*$p < .05$
**$p < .01$
***$p < .001$

Table 2

Pearson Product-Moment Intercorrelations for Play-Space and Analytic Scores for Females

Variable	1	2	3	4	5	6	7	8
1. Mean Areas Entered		.90***	.68**	-.74**	-.74**	-.84***	-.06	.25
2. Area Changes	.90***		.65**	-.64**	-.78***	-.81***	-.02	.40
3. Mean Equipment Used	.68**	.65**		-.62*	-.44	-.66**	-.08	.31
4. Longest Duration (Area)	-.74**	-.64**	-.62*		.87***	.86***	.07	-.26
5. Longest Duration (Equipment)	-.74**	-.78***	-.44	.87***		.91***	.12	-.29
6. Mean Duration (Equipment)	-.84***	-.81***	-.66**	.86***	.91***		-.01	-.17
7. WPPSI Block Design	-.06	-.02	-.08	.07	.12	-.01		-.36
8. PEFT	.25	.40	.31	-.26	-.29	-.17	-.36	

*$p < .05$
**$p < .01$
***$p < .001$

Table 3

Pearson Product-Moment Intercorrelations for Play-Space and Analytic Scores for Males

	Variable	1	2	3	4	5	6	7	8
1.	Mean Areas Entered		.85***	.63**	-.54*	-.51*	-.72***	.19	.21
2.	Area Changes	.85***		.86***	-.52*	-.41	-.73***	.37	-.01
3.	Mean Equipment Used	.63**	.86***		-.38	-.16	-.57*	.24	.13
4.	Longest Duration (Area)	-.54*	-.52*	-.38		.68**	.74***	-.41	-.32
5.	Longest Duration (Equipment)	-.51*	-.41	-.16	.68**		.81***	.02	-.22
6.	Mean Duration (Equipment)	-.72***	-.73***	-.57*	.74***	.81***		-.21	-.21
7.	WPPSI Block Design	.19	.37	.24	-.40	.02	-.21		-.02
8.	PEFT	.21	-.01	.13	-.32	-.22	-.21	-.02	

* $p < .05$
** $p < .01$
*** $p < .001$

A factor analysis (similar rotations of measures) was performed (Table 4) as a further exploration of one aspect of Hypothesis 1 (that a wide coverage of space and use of a wide range of equipment are accompanied by an analytical style of visual perception with the sexes combined). Two factors emerged which were labeled Persistent Behavior and Exploratory Behavior. Factor I, Persistent Behavior, is shown in Table 4, Column 1, and Factor II, Exploratory Behavior, is shown in Column 2. Factor I, Persistent Behavior, is defined best by variable 5, longest duration (equipment), but also loaded heavily with variable 6, mean duration (equipment), and variable 4, longest duration (area).

Variable 1, mean areas entered, and variable 2, area changes, were loaded in the opposite direction to the variables defining Factor I. Therefore, the label for Factor I, Persistent Behavior, reflects the persistence of children who spend more time with few pieces of equipment, in few areas, and who do not make frequent area changes. Variable 8, PEFT, was loaded moderately in a direction opposite that of the duration variables (4, 5, and 6) which defined Factor I. This is consistent with the negative correlations reported previously (Table 1, Row 8, Columns 4, 5, and 6) between the PEFT and the same-duration measures. The factor analysis is also consistent with the positive correlations reported previously (Table 1, Row 8, Columns 1 and 2) between the PEFT and mean areas entered and area changes.

Factor II, Exploratory Behavior, is best defined by variable 3, mean equipment used, and variable 2, area changes. The label for Factor II, Exploratory Behavior, reflects exploration by children who change areas frequently and use a variety of equipment. Note that variable 1, mean areas entered, and variable 2, area changes, appear in both factors, but their loading on Factor I represents the opposite of persistence, and consequently is consistent with the exploratory behavior defining Factor II.

Table 4

Factor Analysis (Similar Rotation of Measures)

Variable	Factor I Persistent Behavior	Factor II Exploratory Behavior
1. Mean Areas Entered	.67	.55
2. Area Changes	.54	.80

(continued)

(Table 4 continued)

3. Mean Equipment Used	.18	.88
4. Longest Duration (Area)	-.84	-.15
5. Longest Duration (Equipment)	-.94	.07
6. Mean Duration (Equipment)	-.88	-.36
7. WPPSI Block Design	-.02	.19
8. PEFT	.49	.08

To determine whether males cover a wider area and use more equipment than females Mahalanobis stepwise descriminant analysis, (D^2) discriminant function test, was performed. At each step one variable is entered into the set of discriminating variables. The variable entered is selected by the first of the following equivalent criteria: the variable with the largest F value; the variable which when partialed on the previously entered variables has the highest multiple correlation with the groups; and the variable which gives the greatest decrease in the ratio of within-to-total generalized variances. A variable is deleted if its F value becomes too low. These steps indicated that variable 3, mean equipment used, was the best single discriminator between males and females, although variable 5, longest duration (equipment), and variable 6, mean duration (equipment), also discriminated well. Even so, none of these three variables reached significance at the five percent level. Nor did the overall test reach significance, although it approached it, but the classification of males and females into groups allowed a Chi-square test to be performed, which was significant ($X^2 = 4.08$, $df = 1$, $p < .05$) (Table 5).

Table 5

Frequency Distribution of Males and Females Classified into Groups

	Males	Females
Males	9	6
Females	3	10

The program also computes canonical correlations and coefficients for canonical variables. It plots the first two canonical variables to give an optimal two-dimensional picture of the dispersion. The discriminant analysis procedure shows the extent to which a subject resembl the members in each of the two groups: in this case, masculine and feminine styles of using space. The probability that a child will fall int a particular group depends on the similarity of his profile to the group mean profile. Although there was some overlapping, males and females could clearly be differentiated in their use of space.

Thus, the discriminant analysis did demonstrate typical masculine and feminine styles of using space, though it was not designed to demonstrate that the masculine style was wider in coverage than the feminine style, as specified in Hypothesis 2. To test whether the masculine and feminine styles were as predicted, the means were computed for all of the play-space scores (Table 6). The differences in means of play-space scores between males and females were in the predicted direction for three out of the five comparisons. The one clear exceptio was, contrary to prediction, the mean for the boys surpassed the girls on variable 5, longest duration (equipment). Also, there was no differe between the two sexes on variable 4, longest duration (area), girls shou have surpassed boys.

Table 6

Means of Play-Space Scores for Males and Females

Variable	Mean	
	Male	Female
1. Mean Areas Entered	9.02	8.19
2. Area Changes	18.46	16.88
3. Mean Equipment Used	13.47	10.62
4. Longest Duration (Area)	87.97	87.85
5. Longest Duration (Equipment)	58.95	55.20
6. Mean Duration (Equipment)	16.50	18.43

For a more refined test of Hypotheses 2, a repeated-measures analysis of variance was used for the three variables that discriminated best in the discriminant function test: 3, mean equipment used; 5, longest duration (equipment); and 6, mean duration (equipment). A repeated-measure analysis was used because there were 12 separate observations on each subject over the quarter, yielding 12 scores for each child on each variable. Table 7 shows that in analysis of variance on variable 3, mean equipment used, the difference between the sexes approached but did not reach significance ($df = 1/26$, $F = 3.80$, $.05 < P < .06$). Time, Source B in the analysis of variance (Table 7), represents the repeated observations over the quarter. The differences between the repeated measures taken on variable 3 for the sexes combined approached significance but did not reach it ($df = 11/286$, $F = 1.61$, $.05 < p < .06$). The interaction between sex of subject and time (Source A x B) was not significant (Table 7). Analyses of variance were also used for variable 5, longest duration (equipment),

Table 7

Analysis of Variance for Sex Difference on Mean Equipment Used

Source	df	MS	F
Sex of Subject (A)	1	682.07	3.80
Error A	26	179.35	
Time (B)	11	78.39	1.61
A x B	11	32.76	
Error B	286	48.76	
Total	335		

In summary, the discriminant function test allowed classification of the males and females into groups that differed significantly in use of space. Inspection of the means and the analysis of variance suggested that the styles were as predicted, i.e., that the males cover a wider area and use more equipment than females, however, significant differences were not obtained.

Another important aspect was that the teacher-child ratio was greater, the density of children was greater, and the noise level was higher within the school building (where the girls preferred to play and the numbered regions were small) than outside. All of these environmental conditions within the school influence a child's concentration, inhibit his exploration, and distract him. Interaction of these special environmental conditions inside the school with the disproportionately small areas makes interpretation of the findings extremely difficult.

One of the most interesting finding was that one of the two analytic measures correlated better with the use of space for girls and the other correlated better for boys. For girls, the PEFT correlated positively with play-space variables having to do with the amount of space covered, the frequency with which they changed areas, and the amount of equipment used (Table 2). For boys, the Block Design correlated better with the play-space scores (Table 3). Perhaps the Block Design is simply a better measure of the preferred cognitive style for boys of this age and the PEFT is a better measure of the preferred style for girls. The PEFT does not require the handling of objects; it merely requires the visual disembedding of the figure. On the other hand, the Block Design actually requires handling the blocks in copying the designs. Young boys enjoy manipulating objects (Goodenough, 1957), they are restless (Otterstaedt, 1962), and they play with blocks more often than girls play with blocks (Farrell, 1957). The PEFT took three times as long to administer as did the Block Design, so, for restless boys, they could demonstrate their cognitive skills more quickly on the Block Design. It seems logical that those boys who did well on the Block Design would be the same ones who covered a wide area of the nursery school and used much of the equipment. For the girls, the PEFT may have favored their cognitive style simply because it did not involve manipulation of materials, but did require more time than the Block Design, allowing the relationship with E to gain in importance.

Garai and Scheinfeld (1968) have reviewed much literature showing that interpersonal relationships are important to excellance in performance by girls. Thus, if the PEFT is a more valid measure of the cognitive style of girls of this age than is the Block Design, it is not surprising that it correlated more closely with their use of play space.

Another interesting finding was that the correlations among the play-space measures were generally higher for girls than for boys (Table 4). The one exception to this trend was that the correlation between variable 2, area changes, and variable 3, mean equipment used, was higher for boys than for girls. Perhaps this is because the use of space is more clearly differentiated for boys than for girls. Variable 3, mean equipment used, was the single variable which best differentiated between the sexes on the discriminant analysis. As mentioned above, the correlation between area changes and mean equipment used was higher for

The results do not confirm Hypothesis 3 (males are perceptually more analytic than females). A two-tailed t-test found no significant difference between males and females on the PEFT (mean for males = 5.92; mean for females = 7.18) nor on the Block Design (mean for males = 6.99; mean for females = 7.28). It is interesting that these two instruments, supposedly both measuring analytic ability, showed a slight negative correlation with each other ($r = -.22$).

Discussion

In evaluating the results, it is essential to describe a flaw in methodology which may have washed out sex differences that might otherwise have appeared and also makes interpretation difficult. The entire nursery school area was subdivided into conspicuously numbered regions. Certain areas within and immediately adjacent to the nursery school building itself were perhaps one third the size of other subdivided areas. Hence, a child who covered a given distance within these regions could enter three times as many numbered areas as a child playing away from the main school building or within another building where the playing blocks were housed. Moreover, a child who entered, say, 10 numbered areas in the main school building might have covered only a third of the geographic space (in contrast to the numbered areas) covered by a child who entered 10 numbered areas away from the main school building. The significance of all of this for the present study is that the boys typically played outside or in the house where the playing blocks were located, both regions of large numbered areas. The girls, on the other hand, typically played within the school, where the numbered areas are small. A girl could therefore receive very high scores representing the number of areas entered and area changes without actually moving very far. A boy, in contrast, could move about a great deal and still receive low scores on these same measures. Even so, the boys generally received higher scores on play-space covered although their real geographical coverage may actually be underestimated by a third.

Another aspect of this methodological flaw is that the numbered areas are of small size within the school building, where most of the equipment is located. This means that the children who preferred to stay inside that building (mainly girls) would receive disproportionately high play-space scores for covering a small geographic area to get to readily available equipment. Nevertheless, the boys had a significantly higher mean on variable 3, mean equipment used, even though less equipment was available outside, where they typically preferred to play. They, however, had to cover a wider geographic space to get to the outside equipment, but the size of the numbered areas representing that space was much larger, thus giving them disproportionately low play-space scores on areas entered and area changes.

boys than for girls. Perhaps boys change areas primarily when they want to use another piece of equipment. This might mean that the critical factor differentiating the sexes is not a wide coverage of space, but rather how the space is utilized. If so, boys use space more functionally; therefore, there is more variation from one play-space variable to another for them, but girls use space based on the personality characteristics of the individual girl; she is either high in play-space use or low, and consistently so in all variables.

Another notable finding was that boys were higher than girls on the one measure that best differentiated the sexes; variable 3, mean equipment used. Practice in the use of equipment should facilitate the development of analytic skills. If this is so, why did not the boys surpass the girls on the analytic measures used in this study? Perhaps because they lag developmentally behind the girls. We know that the baby girl is approximately one month to six weeks ahead of the baby boy at birth and this disparity continues for some time (Garai & Scheinfeld, 1968). But we also know that, by age eight, boys usually surpass girls in field independence (Witkin et al., 1962). The greater practice in the use of equipment that preschool males were observed to have in this study may lay the foundation for the advanced analytic skills to emerge later.